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OBSERVATIONS ON EXPERIMENTAL MENINGITIS IN RABBITS

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Lack of success in producing meningococcus infection with dependable regularity in the smaller laboratory animals has for some time seemed the greatest obstacle in the way of satisfactory evaluation of therapeutic antimeningococcus serums. During January, 1931, a study of the possibility of producing meningococcus meningitis in rabbits was undertaken. These experiments met with a degree of success, but were complicated by several factors which prevented constant and dependable results.

Recently Zdrodowski and Voronine (1) have described the production of meningococcus meningitis in rabbits, using a technique almost identical with our own. These workers succeeded in producing meningitis in 90 per cent of their rabbits, whereas we ourselves obtained this condition with certainty in a smaller proportion of the rabbits injected. A brief summary of our work was published in the PUBLIC HEALTH REPORTS for August 12, 1932 (2).

We are presenting the complete results of this investigation with a twofold purpose in view: (1) Our experiments offer a partial confirmation of those of Zdrodowski and Voronine, and (2) we wish to call attention to some of the features which confuse the interpretation of meningococcus meningitis in rabbits.

EXPERIMENTAL WORK

Choice of cultures for injection.—The most recently isolated strains of meningococci that were available were used, some less than a week after their first cultivation from spinal fluid or blood, and in one group of rabbits it was possible to use the original primary culture which had been planted from spinal fluid the day before (strain 408). In other experiments it was necessary to use strains that had been isolated several weeks.

It was soon found that newly isolated strains varied greatly in virulence, and that, whereas some strains produced meningitis in rabbits, others had no apparent effect even immediately after isolation. On account of this a preliminary titration of our strains for virulence was done in mice, following, in general, the method of Murray (3), but using suspensions of 18-hour "EDB/v" agar cultures

in Ringer's solution instead of weighing out the growth scraped from this medium. The bacterial suspensions were diluted to correspond with standard suspensions of silica (4), so that the approximate number of microorganisms injected was known. For example, a turbidity corresponding to 500 parts per million of silica represented approximately 1,000,000,000 meningococci per c c (5), that with 100 parts per million represented 200,000,000, etc. A strain with a minimum fatal dose for mice of more than 200,000,000 per c c would not often produce any symptoms in rabbits. The mice were injected intraperitoneally in triplicate, each with 1 c c of the diluted suspension per 20 g weight of mouse, and death within 48 hours, with demonstration of meningococci in the blood stream, was taken as a criterion of infection. This determination of the minimum fatal dose for mice was not an accurate indicator of virulence for rabbits, but it served as a valuable guide in choosing strains when many were available.

For the rabbit injections, suspensions of the strains chosen were made, as described above, from 18-hour growth on "EDB/v" agar or rabbits' blood agar in Ringer's solution with a pH of 7.0 to 7.4. The usual dose given to rabbits was 0.2 c c containing one-fifth billion meningococci, though a few rabbits were given as much as one-third billion or as little as one-tenth billion. This seems a large dose, but it is less than is usually required to kill a 20-g mouse.

The strains of meningococci used in these experiments are indicated in Table 1.

TABLE 1.—*The strains of meningococci used and the results of injecting them into rabbits intracisternally*

No.	Strain	Source	Date of isolation	Date of injection into rabbits	Days since isolation	Clinical meningitis in rabbits
1	396	Spinal fluid; moderately severe case in adult; recovered.	11- 1-30	2- 3-31	95 days	None.
2	398	Spinal fluid; fatal case in adult	11-14-30	2- 3-31	81 days	Do.
3	401	Spinal fluid; severe case in child; outcome unknown.	11-25-30	1-29-31	35 days	In 50 per cent.
				2-25-31	62 days	None.
4	406	Spinal fluid; severe case in 10-year-old child; outcome unknown.	2-12-31	4-21-31	67 days	In 50 per cent.
				4-30-31	76 days	In 100 per cent.
				11- 9-31	193 days	None.
5	407	Spinal fluid; severe case in 4-year old child; outcome unknown.	2-21-31	2-25-31	4 days	In 50 per cent.
				4-21-31	54 days	Do.
6	408	Spinal fluid; fatal case in adult	2-24-31	2-25-31	1 day	In 100 per cent.
7	411	Spinal fluid; severe case in child; fatal.	3-13-31	4-21-31	38 days	In 50 per cent.
				4-28-31	45 days	In 60 per cent.
8	413	Blood; fatal fulminating case in 6-year old boy.	3-20-31	4-30-31	40 days	In 75 per cent.
				10-20-31	172 days	In 60 per cent.
				11- 2-31	185 days	None.
9	414	Blood; adult; recovered	3-28-31	5-20-31	54 days	In 75 per cent.
10	419	Spinal fluid; severe case in 2-year-old child; recovered.	4-16-31	5-30-31	25 days	None.
11	198	Spinal fluid; fatal case in adult	3-11-29	11-14-31	2 years or more.	None (cultures).
				7-12-32		In 50 per cent (filtered suspensions).
12	331	Spinal fluid	5- 1-30	7-12-32		In 77 per cent (filtered suspensions).
13	302	do	3-15-30	7-12-32		In 100 per cent (filtered suspensions).
14	267		(1)	7-12-32		None (filtered suspensions).

[1] Older strain.

Method of injection of rabbits.—The rabbits used generally weighed 1,500 to 2,000 grams, though a few were larger or smaller. Weight and temperature were recorded every day with each animal as long as it was under observation. Injections were made directly into the cisterna magna, under light ether anesthesia, by a method devised by Armstrong (6). When this is properly done, the animal shows no untoward effects, and as soon as the anesthesia wears off is able to hop about in a normal lively fashion.

Effects of injections of living virulent cultures upon rabbits.—According to the symptoms that developed after these injections, the 49 rabbits that were given young living cultures may be placed in four general groups:

(1) In this group the symptoms seem to resemble those of the "forme (b)" of Zdrodowski and Voronine. The course of the disease proceeded with such rapidity that it was not easy to follow. Rapid breathing and extreme prostration developed within a few hours after injection, and death followed in 12 to 18 hours, or even earlier in a few cases. Since even slight manipulation frequently causes a rise of temperature in rabbits, the presence or absence of fever in these animals so soon after injection could not be determined satisfactorily. Twelve rabbits showed this rapidly fatal course of symptoms following injection with living cultures. Protocol No. 1 presents the history of rabbit B4, which is a typical example of this group.

(2) This small group of four rabbits was, in many respects, the most interesting of all. The course of the disease was less rapid, giving time for definite and characteristic symptoms to develop. These animals showed no fever. Dyspnea and marked prostration were followed by marked rigidity of the neck. Bending the animal's head even slightly was likely to cause it to cry out as if with pain. The rabbits became very sensitive, and even a touch caused tetanic spasms or convulsions. Death occurred in two to four days. This clinical picture corresponds closely to that described by Zdrodowski and Voronine as "forme (a)." Protocol No. 2 describes the course of infection in rabbit C5, which is similar to that of the other three rabbits showing this clinical picture.

(3) This group of seven rabbits showed paralysis, which developed slowly and which resembled the "forme (c)" referred to by Zdrodowski and Voronine. Usually the paralysis began in the posterior extremities, but occasionally it began in the fore limbs. Respiratory difficulty was a frequent accompaniment of this condition. All of this group of animals except one showed a definite fever (40° to 41.5° C.) on the second or third day after injection, which was usually coincidental with the first evidence of paralysis.

In some of these rabbits the paralysis which developed on the second or third day was slight and the recovery complete within five

to six days after injection. We have neither bacteriological nor histopathological evidence that these recovered animals had meningitis. Nevertheless, the regularity with which paralysis appeared on the second and third days after injection constitutes clinical evidence that makes their inclusion in this third group necessary.

In other animals of this group the paralysis was marked, and involved practically the whole body. In 2 of the 7 death resulted; but the remaining 5 recovered completely in two to six days after the first appearance of symptoms. Protocol No. 3 gives an account of rabbit D1, which showed partial paralysis followed by complete recovery. Protocol No. 4 describes the case of rabbit F8, in which the progressive paralysis proved fatal.

(4) This group of 27 rabbits showed no definite symptoms. All except three showed fever on the second day which was as great as that shown by any rabbit in Group 3 (40° to 41.5° C.). A few developed some weakness of the posterior extremities and had an inclination to walk instead of hop, but there was no definite paralysis, and most of the animals remained lively.

AUTOPSY FINDINGS

All of the rabbits that died were carefully autopsied. Cerebrospinal fluid for study was withdrawn by cisternal puncture before the brain was exposed, and then the top of the skull was removed. There was little to be seen grossly except that the meninges were often adherent, and in two instances purulent clots were found on the surface of the brain. Three or four showed an increased amount of cerebrospinal fluid.

Smears were made from the withdrawn cisternal fluid and from the meninges and were stained by both Wright's and Gram's methods. Cultures were made on blood agar from both of these sources and also from the heart blood. The brain was then removed and placed in Orth's fluid for fixation.

Whenever feasible, total and differential cell counts were made on cisternal fluid. However, the fluid obtained at autopsy was not suitable for making satisfactory counts, because the leucocytes were degenerated and there were but few animals (the four of Group 2 and one of Group 3) which gave an opportunity for the collection of appreciable quantities of such fluid during the severe stage of the disease. Protocol No. 4 describes such a rabbit (F8). Other information could be obtained from the Gram and Wright stained smears of the cisternal fluid drawn just before autopsy. In 11 of the rabbits of Group 1 (those dying in 12 to 18 hours) Gram-negative cocci could be found, either lying freely in pairs or singly, or else within polymorphonuclear leucocytes. Sometimes the leucocytes were filled with cocci. Intra and extra cellular cocci could be seen in similar smears

from all rabbits of Group 2 (those showing characteristic symptoms of meningitis) and in one of the three rabbits dying in Group 3 (those showing progressive paralysis).

BACTERIOLOGICAL FINDINGS

Cultures on blood agar were made from cisternal fluid, from meninges, and from the heart of all rabbits autopsied. Although what were presumably meningococci could be seen in smears from meninges and cisternal fluid of nearly all rabbits inoculated with living cultures, cultures of Gram-negative cocci were obtained from only six—five times from cisternal fluid, twice from meninges, and twice from the heart. When these Gram-negative cocci were first isolated they looked like typical meningococci, both in morphology and in colony appearance. But their identity with the meningococcus could not be proved by any of the means available. The strains given to these rabbits were 408 (Group I) to 2 of the rabbits, 406 (Group III) to 2 rabbits, and 413 (Group III) to 2 rabbits; it was impossible to identify the recovered strains with these. In respect to these bacteriological findings our results are at variance with those of Zdrodowski and Voronine. Whether the cultures of Gram-negative diplococci which we obtained from the six rabbits were microorganisms resembling meningococci which may be found naturally in rabbits, or whether the meningococci were altered by passage through the rabbits, it is impossible to say at the present time.

STUDIES WITH KILLED CULTURES

In protocol No. 5 it can be seen that one of the rabbits receiving living cultures without developing any symptoms, except fever, was killed and its brain was examined histologically. The picture found was essentially identical with that in the brains of the rabbits dying of meningitis.

Failure to recover meningococci, together with the histological findings in the case of this rabbit, suggested that the symptoms produced in these animals might not be due entirely to infection. This idea led to the examination of the brains of several rabbits which had received killed cultures. These rabbits were treated just as the others, except that the suspensions of meningococci were boiled for five minutes before they were injected. Most of these animals showed some fever on the second day, but were otherwise normal and lively. They were chloroformed approximately 24 hours after injection and examined just as were the rabbits described above.

Cultures from these rabbits were invariably negative, but smears from cisternal fluid showed cocci within the abundant polymorphonuclear leucocytes.

The similarity of the histopathologic picture in the brains of rabbits dead of acute meningitis after injection with living cultures and in lively rabbits that had received boiled meningococci is described below. Such findings suggested that the intact meningococci might not be necessary to produce the clinical symptoms noted in the rabbits of Groups 1, 2, and 3. It was decided to use the equivalent of a suspension without the cells.

Rabbits were therefore injected intracisternally with filtered meningococcus suspensions of strains 267, 331, 302, and 198. The filtered suspensions were prepared as for the Shwartzman reaction (7), except that no preservative was added and Berkefeld N instead of V filters were used. Two-tenths of a cubic centimeter was used for each injection.

Of 38 rabbits given intracisternal injections of the filtered suspensions, 26, or 68 per cent, showed definite symptoms of intoxication, and only 2 of the 26 rabbits recovered. These rabbits, as well as those receiving the living virulent cultures, fell into three groups:

(1) The animals in group 1 usually died in 5 to 18 hours. Dyspnea and a marked weakness of limbs developed after an hour, the rabbits hopping only when forced to do so, and then sluggishly. The course of the intoxication was difficult to follow, as was the case with the Group 1 rabbits receiving living virulent cultures. Rabbit M2, an example of this group of 16 rabbits, is described in protocol No. 7. Rabbit M3, one of those which died too quickly for an exudate to form, is described in protocol No. 8.

(2) This group of three rabbits corresponds to Group 2 receiving living cultures. The animals in this group survived long enough for striking symptoms to develop. Prostration increased, sometimes accompanied by fever, and general spasticity with marked rigidity of the neck appeared. The only apparent difference between these animals and those of Group 2 given living cultures was the occurrence of fever, and the number of animals in these groups was too small to justify the drawing of conclusions as to the constancy of this feature. Protocol No. 9 gives an account of rabbit M6 of this group.

(3) This group of seven rabbits showed a progressive paralysis indistinguishable from that seen in the rabbits of the Group 3 that were given living cultures. In 3 of these animals the intoxication was fatal in 23, 41, and 54 hours, respectively; 2 other animals were very ill, the lower part of the body being completely paralyzed for several days; in the remaining 2 the paralysis was marked, but less extensive.

Two other rabbits developed dyspnea and some degree of prostration within two to three hours after injection, but were completely recovered by the next day.

Cultures from the meninges of all of these animals were negative. Smears from cisternal fluid withdrawn just before autopsy showed numbers of polymorphonuclear leucocytes and lymphocytes in all except those rabbits that had died within six to eight hours. In these, the cells were relatively few.

It seems that filtered suspensions of meningococci when injected intracisternally can produce meningitis in rabbits. Clinically, it has been impossible to distinguish the conditions produced in these animals by virulent living cultures and those produced by the filtered suspensions.

It is interesting to note that the cultures used for preparing the filtered suspensions were not in themselves sufficiently virulent to kill rabbits in the one-fifth billion cell doses that were given. The filtered suspensions were quite concentrated and represented the fluid which had suspended many times this dose.

PATHOLOGIC HISTOLOGY

The following material was subjected to histologic examination:

(1) Brain from 13 animals inoculated with living meningococci, falling into the following clinical groups: Seven in Group 1, three in Group 2, two in Group 3, and one in the febrile, otherwise asymptomatic, Group 4.

(2) Brain from three animals killed 24 hours after intracisternal injection of boiled meningococci.

(3) Brain from six animals dying or killed *in extremis* after injection of filtered meningococcus suspensions.

The brains were removed and fixed entire either for 48 hours in Orth's fluid (2.5 per cent aqueous solution of potassium bichromate 10 parts, concentrated formalin 1 part), or in a solution containing 4 per cent formaldehyde and 0.9 per cent sodium chloride, kept over calcium carbonate for one or more days and followed by further hardening in 2.5 per cent potassium bichromate for 48 hours. From these bichromate solutions the brains were transferred directly to 50 per cent alcohol for 8 to 16 hours, then for a similar period to 80 per cent alcohol. Blocks were then cut, usually five transverse sections—through the cerebrum and caudate nuclei, through the thalamus, hippocampi, and parietal cortex, through the oculomotor roots, anterior colliculi, and often the adherent occipital cortex, through the pons and cerebellum, and through the enlargement of the medulla. Dehydration was completed in three changes of U. S. P. acetone; clearing followed in benzol or gasoline (cleaner's grade), and the blocks were embedded in paraffin *in vacuo*. Sections of 5 μ to 8μ thickness were stained in iron chloride hematoxylin (Weigert) and picrofuchsin (Freeborn-Van Gieson), in toluidine blue, by a Gram method (8), and in buffered eosin-polychrome methylene blue (9).

The major significant histologic finding was a purulent or fibrinopurulent leptomeningitis. (Figs. 1, 2, 3.) This was generally most marked over the base of the pons and cerebral peduncles, around the mid-brain and thalamus, and in the cerebellopontine angles. With denser and more extensive meningeal exudation, polymorphonuclear infiltration extended inward in the sheaths of perforating vessels, marginal purulent infiltration (figs. 1, 4) of the brain substance appeared in various locations, and miliary intracerebral abscesses (fig. 5) were found. In such more extensive meningitides, purulent and sanguinopurulent exudates were sometimes found in the ventricles. (Fig. 6.) Other inconstant findings were edema and lymphocyte infiltration of the chorioid plexi, and meningeal and intracerebral hemorrhages. (Fig. 1.)

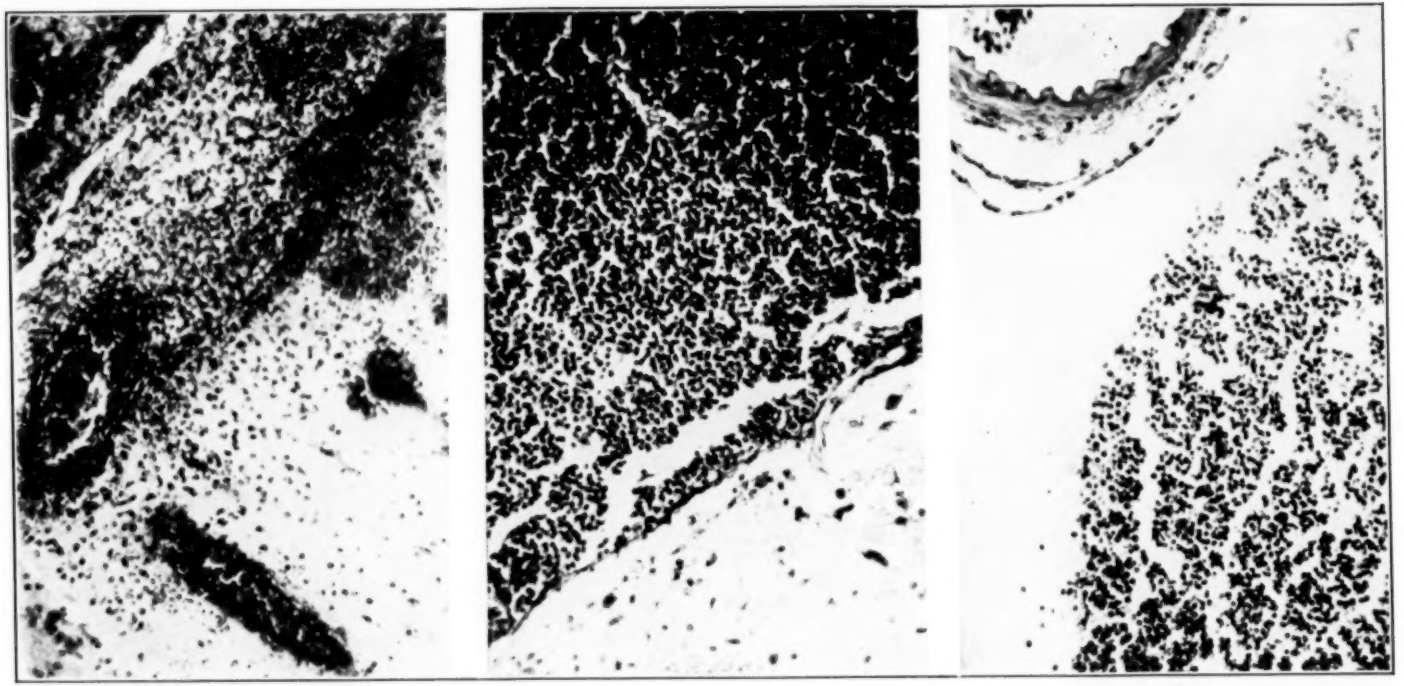
The most extensive changes were present in three animals killed 24 to 48 hours after injection. All of these showed the spastic rigidity symptom complex; two were inoculated with living cocci (protocol 2), one with filtered suspension (protocol 9). Less marked changes were present in animals dying 11 to 18 hours after inoculation and showing no definite neurologic symptoms. These comprised seven inoculated with living cultures (protocol 1) and three with filtered suspensions (protocol 7). In five of this group there was a variable amount of lymphocyte admixture in the meningeal exudate. It is doubtful whether this lymphocyte exudation was due to the injection of meningococci, as such exudates are frequently seen in supposedly healthy animals. Thirteen of a series of twenty apparently healthy rabbits examined in this laboratory to determine the prevalence of the "spontaneous" granulomatous meningo-encephalitis of rabbits showed lymphocyte infiltration in the meninges. Hence this type of meningeal exudation in animals under experiment is often assignable rather to this "spontaneous" encephalitis than to the experimental procedure.

In the animal (protocol 5) from the febrile, otherwise symptom-free, Group 4, which was killed 24 hours after inoculation, the picture of this "spontaneous" encephalitis dominated, and there was only slight diffuse and focal admixture of polymorphonuclear leucocytes in the meningeal exudate.

Moderate (in 1) and marked (in 2) meningeal reactions were seen in the 3 rabbits killed 24 hours after injection with boiled meningococci. (Protocol 6.)

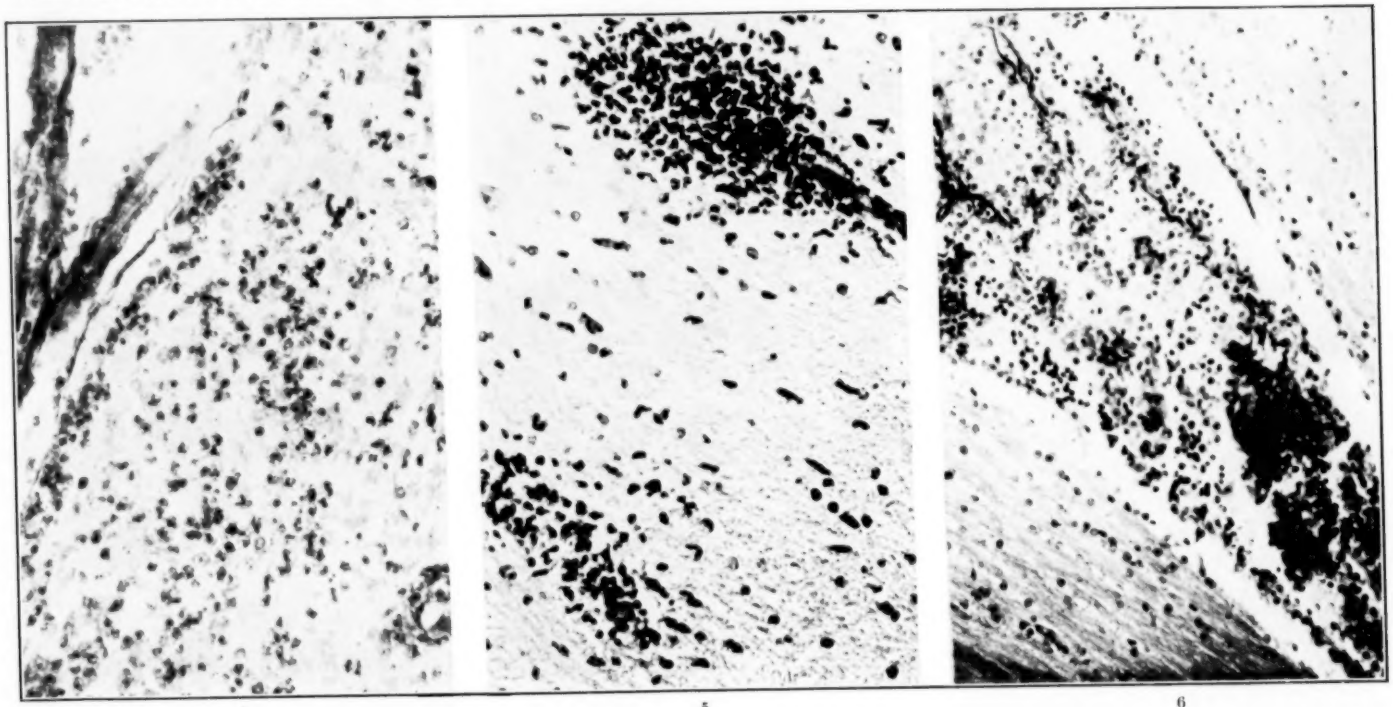
The two animals (protocol 8) dying eight hours after injection of filtered suspension showed toxic degenerative changes in nerve cells and no evident meningeal reaction.

The meningeal reaction became subacute in type in two animals killed on the sixth day (Groups 2 and 3 given living cocci). The previous purulent exudate was reduced to small encapsulating foci of fragmented leucocytes and fibrin. Elsewhere a diffuse exudation of



1 2 3

1, Rabbit B4, showing meningitis with marginal purulent infiltration and hemorrhage in occipital cortex adjacent to midbrain. Given living culture of meningococcus 407. 2, Rabbit L1, showing purulent meningeal exudate on base of thalamus. Given boiled suspension of meningococcus 433. 3, Rabbit M6, showing purulent menigeal exudate on base of pons. Given filtered suspension of meningococcus 198



4 5 6

4, Rabbit L1, showing purulent marginal infiltration of dorsum of thalamus. Given boiled suspension of meningococcus 433. 5, Rabbit C5, showing miliary abscesses in thalamus. Given living cultures of meningococcus 411. 6, Rabbit L2, showing purulent exudate, choroid plexus of lateral ventricle. Given boiled suspension of menigococcus 433

lymphocytes, plasma cells and a few macrophages, and patches of fibroblast proliferation had appeared. In a rabbit dying of progressive paralysis 16 days after injection with living cocci (protocol 4) the lymphoid exudation was reduced, the purulent foci had disappeared, and fibroblast proliferation was no longer evident.

Thus an essentially identical histologic picture was produced by inoculation with living meningococci, boiled cocci, and filtered suspensions. The variations in intensity of the histologic reaction were correlated with the time interval from inoculation to death, rather than with the inoculum used. The tendency to invasion of the brain substance was possibly less after inoculation with filtered suspensions than with living or boiled cocci. The slightest reaction occurred in an animal from the asymptomatic Group 4.

DISCUSSION

It seems evident that clinical and pathological meningitis can be produced in rabbits by intracisternal injection of sufficiently virulent meningococci.

This condition was produced with certainty in only 39 per cent of the rabbits given living cultures. This 39 per cent does not include rabbits showing mild symptoms and from which neither bacteriological nor pathological evidence of meningitis was obtained.

The clinical pictures found in these animals resembled those of the three forms of meningitis in rabbits described by Zdrodowski and Voronine, viz.: (1) An acute form, terminating fatally in 12 to 18 hours; (2) a form accompanied by spasticity, retraction of head, rigidity of neck, and a sensitiveness to touch, which ended fatally in 2 to 3 days; (3) a progressive paralysis, either terminating fatally in 3 to 16 days or resulting in complete recovery.

The clinical effects of intracisternal injections of living cultures in rabbits were by no means regular. Though individual variation in resistance among rabbits no doubt played a part, the most important factor seemed to be the virulence of the meningococci used in the experiments. Strains of low virulence have been of almost no value in producing clinical symptoms in rabbits in the doses given. The tendency of meningococci to lose virulence within a short time is shown in Table 1.

It is possible that the difference between the percentage of rabbits developing clinical meningitis in the experiments of Zdrodowski and Voronine (90 per cent) and the percentage in our own (39 per cent) may be due to differences in degree of initial invasiveness. Zdrodowski and Voronine have reported considerable success in the maintenance of the virulence of their strains upon Dorsett's egg medium.

Histopathological examination of the brains of rabbits dying from the clinical conditions described above revealed a picture of acute or

subacute meningitis, with a meningeal exudate composed chiefly of polymorphonuclear leucocytes with a variable amount of fibrin and of lymphocytes.

A feature deserving attention in these studies was the failure to recover cultures of organisms that were certainly meningococci from the rabbits given living cultures, although typical Gram-negative diplococci could be seen abundantly in the meninges and cisternal fluid, both inside and outside of leucocytes. In a true infectious process it should, theoretically, be possible to recover the meningococcus in some of the rabbits. Although organisms resembling the meningococcus were removed from six, their identity could not be proved.

A histopathologic picture identical with that found in the brains of animals dying of meningitis after injection with living cultures was found in those which had received boiled suspensions of meningococci, although these latter animals showed no symptoms whatever.

Filtered, cell-free suspensions of several strains of meningococci have caused the death of rabbits, producing symptoms indistinguishable from those of the rabbits in our groups 1, 2, and 3, which seem to correspond to the three forms of meningitis described by Zdrodowski and Voronine. Sixty-eight per cent of the rabbits injected with these filtrates developed one of these clinical forms, and all except two of these died. The brains of these rabbits presented a histopathological picture indistinguishable from that obtained in rabbits which died from injections of living virulent meningococci and in those which were killed 24 hours after being given boiled cells. Exceptions to these findings were seen in those rabbits which died within eight hours after injection and in which there had not been enough time for the exudate to form.

Failure to recover the meningococcus with certainty, occurrence of a histopathological picture of acute meningitis in animals receiving boiled cultures, and the appearance of all clinical symptoms and histopathologic features of meningitis in animals given filtered suspensions of meningococci suggest that such filtrates contain "toxins" that may play an important rôle in meningitis in rabbits.

The nature of these "toxins" and their relation to "virulence" in meningococci can not be discussed here. That a true soluble toxin may play an important rôle in meningitis is suggested by the work of Ferry, Norton, and Steele (10), who have described the protection of infected monkeys by antitoxin prepared by immunizing horses with filtrates of broth cultures of meningococci. The effect of "endotoxins" of meningococci upon laboratory animals when injected intraperitoneally or intravenously has been long known, and was discussed in considerable detail by Gordon (11) in 1920.

It should be borne in mind that these "toxins" as used by us were very concentrated (7), and that the 0.2 c c given to rabbits represented the fluid which suspended many times the number of cells that were injected when the whole suspensions were used. The preparations used in these experiments were made as were the "toxic substances" used to produce the Shwartzman phenomenon, but it is not possible to know at present just what the relation of these toxins to the Shwartzman active agent may be.

SUMMARY

It is possible to produce both a clinical and a histopathologic picture of acute meningitis in rabbits by intracisternal injection of virulent strains of meningococci.

A histopathologic picture identical with that found in the brains of animals dying of meningitis was found in those which had received boiled suspensions of meningococci and which showed no untoward effects.

Clinical pictures, usually resulting fatally, corresponding to those observed in the rabbits dying of acute meningitis after intracisternal injection of living cocci, were produced in other rabbits by similar injections of filtered suspensions of meningococci. The histopathologic picture in these animals was essentially identical with that found in those receiving the living and boiled cultures.

These findings suggest that experimental meningitis in rabbits may not necessarily be an infection and that intoxication may play an important rôle.

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PROTOCOLS

PROTOCOL NO. 1—RABBIT B4

2/25/31. Weight, 870 g;[1] temperature, 40° C. Given one-fifth billion cells (0.2 c c) of meningococcus strain 407 intracisternally. Animal lively and active

[1] In these protocols g = grams.

after injection. Died in 14 hours. Cloudy spinal fluid withdrawn before autopsy showed numerous cocci free and inside of polymorphonuclear leucocytes. Cultures from cisternal fluid and from heart were negative for all bacteria.

Brain: Dense fibrinopurulent exudation in the pia mater of the mid-brain, thalamus, in patches over the cerebral cortex, and over cerebellum and pons, with little invasion of deeper cerebellar sulci. Dense polymorphonuclear infiltration of the superficial layers of the cerebral substance is seen in part of the temporoparietal and occipital cortex, thalamus, mid-brain, a few gyri of the cerebellum, and slight on the base of the pons. Polymorphonuclear infiltration with accompanying thrombosis extends in along the sheaths of some vessels in cerebral cortex and thalamus. The ventricle and chorioid plexi are not involved. Some areas of meningeal hemorrhage are seen.

Many Gram-negative intracellular diplococci are in the meningeal exudate and some in the superficial cortical infiltration.

Diagnosis: Meningitis, acute.

PROTOCOL NO. 2—RABBIT C5

4/21/31. Weight, 1,370 g; temperature, 38.9° C. Given one-fifth billion meningococci of strain 411 (0.2 c c) intracisternally. Animal normal and active after injection. Within four hours showed definite prostration and dyspnea.

4/22/31. Weight, 1,100 g; temperature, 36.8° C. Complete prostration; head retracted; convulsions when handled.

Chloroformed in late afternoon when moribund. Cisternal and spinal fluid abundant and cloudy. Both full of polymorphonuclear leucocytes, and with abundant extracellular and intracellular cocci. Cultures from cisternal and spinal fluids and from heart were negative for all bacteria.

Brain: Dense polymorphonuclear infiltration of pia over base, over cerebellum, in cerebellar sulci, in major fissures of cerebrum, scanty over convexity, with scattered fibrin clots and few lymphocytes. Polymorphonuclear infiltration along sheath of occasional perforating vessel, occasional miliary intracerebral abscesses, most numerous in thalamus. Few leucocytes in fourth ventricle; none in third or lateral ventricles. A few, occasionally paired, Gram-negative cocci are made out, sometimes in leucocytes.

Diagnosis: Leptomeningitis, acute purulent.

PROTOCOL NO. 3—RABBIT D1

4/28/31. Weight, 1,930 g; temperature, 39.4° C. Given one-fifth billion meningococci of strain 411 (0.2 c c). Lively and active after injection.

4/29/31. Weight, 1,800 g; temperature, 40.6° C. No symptoms.

4/30/31. Weight, 1,690 g; temperature, 40.3° C. Very sensitive to touch. Rapid and deep respiration. By 4 p. m. had lost use of limbs.

5/1/31. Weight, 1,705 g; temperature, 40° C. Much better.

5/4/31. Weight, 1,750 g; temperature, 39° C. Completely recovered.

PROTOCOL NO. 4—RABBIT F8

5/20/31. Weight, 1,200 g; temperature, 39.6° C. Given one-fifth billion meningococci (0.2 c c) of strain 419 intracisternally.

5/21/31. Weight, 1,160 g; temperature, 39.6° C. Complete paralysis of hind limbs.

5/22/31. Weight, 1,120 g; temperature, 40.2° C.

Increased and extended paralysis. Cisternal puncture done, removing 0.4 c c of cloudy fluid. This fluid had total cell count of 110,000 per cu. mm. A differential count showed 87 per cent polymorphonuclear leucocytes and 13 per cent lymphocytes. Meningococci were not certainly seen, and cultures were negative.

5/28/31. Weight, 950 g; temperature, 38.4° C. Complete paralysis of fore limbs as well as hind limbs.

6/1/31. Weight, 890 g; temperature, 38.6° C.

6/5/31. Died 8 a. m. Cultures from meninges and heart negative.

Brain: Some pericellular edema in cortex, some pial edema and slight diffuse lymphocyte and macrophage infiltration, in places denser, lymphocytic and perivascular, especially basally and in superior longitudinal sulcus.

No focal intracerebral lesions.

Diagnosis: Leptomeningitis, subacute.

PROTOCOL NO. 5—RABBIT G1

10/20/31. Weight, 2,200 g; temperature, 39.4° C.
10/21/31. Weight, 2,190 g; temperature, 39.4° C. Given one-fifth billion meningococci of strain 413 (0.2 c c) intracisternally.
10/22/31. Weight, 2,040 g.; temperature, 41° C. Well and lively. Chloroformed 24 hours after injection. Cisternal fluid showed polymorphonuclear leucocytes and some lymphocytes. No cocci were definitely seen. Cultures were negative.
Brain: Dense irregular infiltration of pia with lymphocytes and fewer polymorphonuclears, the latter predominating in scattered foci. Infiltration is especially marked basally in the superior longitudinal fissure, in the cerebellopontine angles, and around the mid-brain and thalamus.
The chorioid plexi of the third, fourth, and lateral ventricles showed patchy lymphocyte infiltration, and there was some polymorphonuclear and lymphocyte exudate in each of the ventricles. The plexal epithelium contained large intracellular (fat) vacuoles in most of the cells.
Lymphocyte infiltration was seen in the sheaths of a few intracerebral vessels, and typical centrally necrotic epithelioid cell granulomata were seen in the Ammon's horns.
Diagnosis: Subacute meningochorioiditis; granulomatous meningoencephalitis.

PROTOCOL NO. 6—RABBIT G5

10/20/31. Weight, 1,700 g; temperature, 39.6° C.
10/21/31. Weight, 1,750 g; temperature, 39.4° C. Given one-fifth billion meningococci (0.2 c c) of strain 413, boiled for five minutes, intracisternally.
10/22/31. Weight, 1,570 g; temperature, 40.7° C. Well and active. Chloroformed 24 hours after injection. Cisternal fluid showed abundant polymorphonuclear leucocytes and some lymphocytes. Cocci were not seen with certainty, and all cultures were negative.
Brain: One lateral ventricle contained a few clumps of leucocytes and its chorioid plexus showed slight lymphocyte infiltration. Moderate purulent pial exudate on base of temporal lobes, in temporothalamic angles, more on dorsum of thalamus and in superior longitudinal fissure behind splenium, with slight marginal leucocyte infiltration in the thalamus. Moderate purulent exudate in pia on base of pons. More extensive and fibrinopurulent in some of cerebellar sulci, with hemorrhages and leucocyte infiltration in molecular layer of adjoining cerebellar cortex. Slight to moderate purulent infiltration in pia on base and in superior longitudinal fissure in frontal region, with some leucocyte infiltration of the mesiodorsal cortex. Marginal polymorphonuclear infiltration was present in the colliculi, and the mesencephalic pia showed slight to moderate exudation. Similar purulent meningeal exudate was present in smaller amounts on the base and sides of the medulla and upper cervical cord.
Diagnosis: Leptomeningitis, acute purulent.

PROTOCOL NO. 7—RABBIT M2

7/13/32. Weight, 2,200 g; temperature, 39.4° C.
7/14/32. Weight, 2,205 g; temperature, 39.2° C. Given 0.2 c c filtered suspension of strain 302 at 2.30 p. m. intracisternally.
Animal well and lively after injection.
7/15/32. Died at 8.45 a. m. Cultures from cisternal fluid and heart were negative.
Brain: Meninges infiltrated by pseudoeosinophil leucocytes, a minority of lymphocytes and occasional macrophages especially on base of and around midbrain, pons and cerebellum, and thalamus. Edema and slight lymphocyte infiltration of chorioid plexi.
Diagnosis: Acute leptomeningitis.

PROTOCOL NO. 8—RABBIT M3

7/12/32. Weight, 1,980 g; temperature, 39.2° C.
7/13/32. Weight, 1,975 g; temperature, 39.2° C.
7/14/32. Weight, 1,975 g; temperature, 39.1° C. Given 0.2 c c of filtered suspension of strain 302 at 2.35 p. m. Animal well and lively after injection. By 4 p. m. showed dyspnea and slight prostration. Died 10.10 p. m.
Very little cisternal fluid. Cultures from it were negative.

Brain: No meningeal exudation further than few scattered lymphocytes. Diffuse degeneration of nerve cells.

Diagnosis: Toxic degeneration.

PROTOCOL NO. 9—RABBIT M6

7/12/32. Weight, 2,300 g; temperature, 39.8° C.

7/13/32. Weight, 2,300 g; temperature, 39.6° C.

7/14/32. Weight, 2,290 g; temperature, 39.4° C. Given 0.2 c c of filtered suspension of meningococcus strain 198. Well and lively immediately after injection. Seemed to feel ill during the second hour.

7/15/32. Weight, 2,210 g; temperature, 40 7° C. Marked prostration and weakness.

7/16/32. Weight, 2,170 g; temperature, 40.8° C. Spasticity all over, with marked retraction of head and rigidity of neck, which became more and more pronounced. At 12 o'clock withdrew 0.2 c c cloudy cisternal fluid which showed lymphocytes and polymorphonuclear leucocytes. Cultures were negative. At 4 p. m., when moribund, the animal was chloroformed and the brain removed.

Brain: Reduction in number, pyknosis, vacuolation, and fraying of Purkinje cells. Well-preserved nerve cells in nuclei in brain stem.

Pia: Dense purulent infiltration and marked thickening over base of pons, slight on convexity, laterally some light diffuse polymorphonuclear infiltration in cerebellar cortex. Similar dense meningeal infiltration appeared on the base of the mid-brain and thalamus, extending around the latter in moderate grade, slight in the median longitudinal fissure above the corpus callosum and between the anterior colliculi. Edema of chorioid plexi, serous and leucocytic exudate in third ventricle, lymphocytes in lateral ventricles.

Diagnosis: Acute leptomeningitis.

DEATHS DURING WEEK ENDED OCTOBER 15, 1932

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Oct. 15, 1932	Corresponding week, 1931
Data from 85 large cities of the United States:		
Total deaths	7,130	6,917
Deaths per 1,000 population, annual basis	10.2	10.0
Deaths under 1 year of age	542	628
Deaths under 1 year of age per 1,000 estimated live births [1]	45	49
Deaths per 1,000 population, annual basis, first 41 weeks of year	11.1	11.9
Data from industrial-insurance companies:		
Policies in force	70,259,724	74,607,364
Number of death claims	10,494	11,041
Death claims per 1,000 policies in force, annual rate	7.8	7.7
Death claims per 1,000 policies, first 41 weeks of year, annual rate	9.6	9.8

[1] 1932, 81 cities; 1931, 77 cities.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for Weeks Ended October 22, 1932, and October 24, 1931

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 22, 1932, and October 24, 1931

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931
New England States:								
Maine	3	5	----	2	----	129	1	0
New Hampshire	----	3	----	----	----	1	0	0
Vermont	----	----	----	----	----	41	0	0
Massachusetts [1]	20	48	2	11	51	30	2	3
Rhode Island	10	5	1	----	----	81	0	0
Connecticut	1	4	2	4	7	8	0	1
Middle Atlantic States:								
New York	56	67	[2] 15	[2] 7	123	67	4	8
New Jersey	24	32	23	6	82	11	1	0
Pennsylvania	107	106	----	----	148	116	2	10
East North Central States:								
Ohio	87	102	5	1	38	12	0	2
Indiana	108	68	26	8	6	42	0	2
Illinois	123	99	21	10	33	24	5	5
Michigan	23	35	11	----	46	29	0	2
Wisconsin	17	14	30	14	27	8	0	3
West North Central States:								
Minnesota	31	14	----	----	67	8	2	1
Iowa	23	22	----	----	4	7	0	0
Missouri	74	116	----	3	15	7	0	2
North Dakota	1	6	----	----	9	1	0	1
South Dakota	7	4	----	----	3	39	0	0
Nebraska	33	19	1	2	----	1	0	0
Kansas	46	42	2	----	7	11	0	1
South Atlantic States:								
Delaware	6	3	----	1	2	1	0	0
Maryland [1]	20	36	4	5	4	12	1	1
District of Columbia	2	24	1	----	3	----	0	0
Virginia	72	----	----	----	31	----	0	----
West Virginia	82	104	13	20	32	28	1	0
North Carolina	92	186	5	8	42	24	0	0
South Carolina	31	58	379	294	3	----	0	0
Georgia [1]	70	53	----	17	2	8	0	0
Florida	20	32	3	----	2	66	0	0
East South Central States:								
Kentucky	77	171	6	----	12	----	0	0
Tennessee	108	177	33	11	1	6	3	6
Alabama [1]	110	107	27	5	8	3	0	0
Mississippi	44	165	----	----	----	----	0	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 22, 1932, and October 24, 1931—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931
West South Central States:								
Arkansas	58	66	36	1	1	5	0	1
Louisiana [1]	31	61	6	9	1	3	1	1
Oklahoma [4]	99	89	33	17	3	----	0	0
Texas [1]	233	65	54	9	10	----	0	3
Mountain States:								
Montana	1	----	----	----	208	25	0	0
Idaho	9	----	----	----	----	1	0	0
Wyoming	1	----	----	1	4	----	0	2
Colorado	8	9	----	----	2	----	0	0
New Mexico	54	24	12	----	2	----	0	0
Arizona [4]	4	4	61	----	----	1	0	0
Utah [3]	1	1	----	7	2	----	0	0
Pacific States:								
Washington	1	7	----	----	2	----	0	1
Oregon	2	3	56	22	11	5	0	1
California	60	82	450	37	21	68	0	2
Total	2,090	2,388	1,318	502	1,070	928	23	59

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931
New England States:								
Maine	6	11	18	10	1	0	9	8
New Hampshire	0	1	4	3	0	0	0	0
Vermont	0	3	2	7	0	0	0	0
Massachusetts [1]	0	40	204	167	0	0	6	14
Rhode Island	0	2	30	11	0	0	1	3
Connecticut	0	39	32	30	0	0	0	7
Middle Atlantic States:								
New York	9	184	240	238	7	1	24	50
New Jersey	12	36	111	75	0	0	8	7
Pennsylvania	32	23	279	252	0	0	50	106
East North Central States:								
Ohio	1	2	412	278	0	1	32	29
Indiana	1	3	116	85	1	13	19	9
Illinois	8	32	316	201	2	2	36	45
Michigan	6	41	197	114	0	0	19	16
Wisconsin	2	37	45	51	0	0	2	5
West North Central States:								
Minnesota	4	37	58	46	0	0	2	2
Iowa	2	10	37	31	3	25	18	6
Missouri	0	2	148	69	0	8	22	31
North Dakota	0	2	7	8	1	2	2	12
South Dakota	0	0	0	17	0	2	1	2
Nebraska	0	1	39	15	5	2	2	3
Kansas	2	0	82	66	0	4	1	7
South Atlantic States:								
Delaware	0	0	8	7	0	0	2	2
Maryland [3]	1	4	60	78	0	0	14	35
District of Columbia	4	0	16	15	0	0	0	3
Virginia	4	1	88	----	0	1	23	----
West Virginia	1	6	70	45	1	0	42	73
North Carolina	1	1	98	131	0	0	5	29
South Carolina	0	0	13	35	0	0	15	15
Georgia [1]	2	0	36	27	0	2	37	33
Florida	2	1	6	9	0	0	2	5
East South Central States:								
Kentucky	0	0	66	86	0	0	20	60
Tennessee	1	1	106	84	0	1	22	59
Alabama [1]	0	0	60	65	1	0	18	19
Mississippi	0	1	26	43	1	42	4	14

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 22, 1932, and October 24, 1931—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931	Week ended Oct. 22, 1932	Week ended Oct. 24, 1931
West South Central States:								
Arkansas	0	0	47	26	0	2	9	17
Louisiana [1]	0	1	20	16	1	1	13	33
Oklahoma [4]	0	2	22	37	0	3	24	44
Texas [1]	1	3	86	22	4	0	18	33
Mountain States:								
Montana	0	2	8	13	4	0	9	4
Idaho	0	2	1	6	0	2	6	4
Wyoming	0	0	15	6	0	1	3	0
Colorado	0	0	25	21	0	0	1	8
New Mexico	0	0	13	6	0	1	12	13
Arizona [5]	0	1	5	5	0	0	1	1
Utah [3]	0	0	1	5	0	0	0	4
Pacific States:								
Washington	0	9	15	67	2	9	5	6
Oregon	4	2	21	15	0	7	3	2
California	4	6	79	226	1	7	14	6
Total	110	549	3,397	2,870	35	139	576	887

[1] Typhus fever, week ended Oct. 22, 1932, 23 cases: 1 case in Massachusetts, 8 cases in Georgia, 6 cases in Alabama, 1 case in Louisiana, and 7 cases in Texas.
[2] New York City only.
[3] Week ended Friday.
[4] Figures for 1932 are exclusive of Oklahoma City and Tulsa a nd for 1931 are exclusive of Tulsa only.
[5] Rocky Mountain spotted fever, week ended Oct. 22, 1932, 1 case in Arizona.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
September, 1932										
Illinois	5	226	22	17	51	----	30	484	5	180
Louisiana	3	92	27	175	14	16	7	34	0	68
Maryland	2	61	16	1	12	1	10	101	0	141
Minnesota	6	54	6	----	44	----	36	119	0	31
New York	16	162	----	6	325	----	80	496	2	201
North Carolina	7	264	47	----	85	125	7	223	1	96
Oklahoma [1]	1	239	67	206	7	21	6	77	0	139
Rhode Island	1	15	----	----	[2] 16	----	3	40	0	2
West Virginia	2	149	22	1	43	----	18	164	8	201

[1] Exclusive of Oklahoma City and Tulsa.

[2] Delayed reports included.

September, 1932

Anthrax:	Cases
Louisiana	2
Chicken pox:	
Illinois	165
Maryland	22
Minnesota	53
New York	219
North Carolina	36
Oklahoma [1]	6
Rhode Island	5
West Virginia	11
Conjunctivitis:	
Oklahoma [1]	1
Diarrhea:	
Maryland	97

Dysentery:	Cases
Illinois (amebic)	5
Illinois (bacillary)	46
Louisiana	1
Maryland	31
Minnesota	3
Minnesota (amebic)	1
New York	45
Oklahoma [1]	4
German measles:	
Illinois	5
Maryland	8
New York	219
North Carolina	8
Hookworm disease:	
Louisiana	30

Impetigo contagiosa:	Cases
Maryland	92
Oklahoma [1]	1
Lead poisoning:	
Illinois	12
Maryland	1
Lethargic encephalitis:	
Illinois	6
Louisiana	3
Maryland	2
Minnesota	1
New York	7
Mumps:	
Illinois	41
Maryland	35
Oklahoma [1]	13

[1] Exclusive of Oklahoma City and Tulsa.

Mumps—Continued.	Cases
Rhode Island	11
West Virginia	1
Ophthalmia neonatorum:	
Illinois	9
Louisiana	1
Minnesota	2
New York	3
North Carolina	1
Paratyphoid fever:	
Illinois	6
New York	7
North Carolina	3
Psittacosis:	
Minnesota	11
Puerperal septicemia:	
Illinois	4
Rabies in animals:	
Illinois	3
Louisiana	7
Maryland	2
New York [1]	3
Rabies in man:	
Illinois	1
Scabies:	
Maryland	1
Oklahoma [1]	1

Septic sore throat:	Cases
Illinois	6
Louisiana	1
Maryland	6
New York	8
North Carolina	19
Oklahoma [1]	29
Rhode Island	1
Tetanus:	
Illinois	11
Louisiana	10
Maryland	2
New York	12
Rhode Island	2
Trachoma:	
Illinois	1
Minnesota	2
Oklahoma [1]	6
Trichinosis:	
Illinois	2
New York	2
Tularaemia:	
Illinois	2
Louisiana	2
Maryland	1
Minnesota	5

Typhus fever:	Cases
Illinois	1
Louisiana	2
Maryland	3
New York	1
North Carolina	4
Undulant fever:	
Illinois	5
Louisiana	4
Maryland	11
Minnesota	2
New York	23
North Carolina	1
Vincent's angina:	
Illinois	27
Maryland	15
New York [2]	86
Oklahoma [1]	5
Whooping cough:	
Illinois	394
Louisiana	8
Maryland	114
Minnesota	134
New York	1,403
North Carolina	256
Oklahoma [1]	14
Rhode Island	64
West Virginia	104

[1] Exclusive of Oklahoma City and Tulsa. [2] Exclusive of New York City.

WEEKLY REPORTS FROM CITIES

City reports for week ended October 15, 1932

State and city	Diphtheria cases	Influenza cases	Influenza deaths	Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
Maine:											
Portland	0	-------	1	0	1	4	0	2	1	3	27
New Hampshire:											
Concord	0	-------	0	0	0	0	0	0	0	0	7
Manchester	0	-------	0	0	3	0	0	2	0	0	25
Nashua	0	-------	0	0	0	1	0	0	0	0	-------
Vermont:											
Barre	1	-------	0	1	0	0	0	0	0	0	2
Burlington	0	-------	0	0	0	0	0	0	0	0	16
Massachusetts:											
Boston	7	-------	0	8	22	28	0	10	1	24	200
Fall River	0	-------	0	0	1	2	0	1	0	2	24
Springfield	0	-------	0	1	0	2	0	1	0	2	26
Worcester	1	-------	0	2	3	7	0	3	0	2	40
Rhode Island:											
Pawtucket	0	-------	0	0	2	0	0	0	0	0	-------
Providence	2	-------	0	0	2	5	0	1	1	10	61
Connecticut:											
Bridgeport	0	1	0	2	4	5	0	1	0	4	26
Hartford	0	-------	0	1	1	0	0	2	0	3	35
New Haven	0	-------	1	0	5	2	0	0	0	8	35
New York:											
Buffalo	5	-------	1	2	7	12	0	6	1	0	112
New York	19	12	8	28	97	39	0	64	16	93	1,264
Rochester	0	-------	0	0	5	11	0	1	0	2	61
Syracuse	0	-------	0	1	2	8	0	1	0	22	46
New Jersey:											
Camden	9	-------	0	1	2	3	0	1	0	0	17
Newark	1	3	0	0	6	5	0	2	0	19	81
Trenton	0	-------	1	0	5	1	0	1	0	0	44
Pennsylvania:											
Philadelphia	4	2	3	4	16	20	0	37	7	16	392
Pittsburgh	5	1	1	5	16	17	0	6	0	17	145
Reading	2	-------	0	18	1	4	0	3	0	1	32
Scranton	1	-------	0	0	0	5	0	0	0	2	-------
Ohio:											
Cincinnati	4	-------	0	0	4	15	0	5	2	2	132
Cleveland	6	44	1	0	4	41	0	10	1	22	153
Columbus	4	-------	0	4	4	2	0	4	1	1	79
Toledo	4	-------	0	3	4	28	0	2	0	1	51
Indiana:											
Fort Wayne	9	-------	0	0	2	0	0	0	0	0	-------
Indianapolis	1	-------	0	0	9	10	0	0	1	7	-------
South Bend	1	-------	0	0	1	1	0	1	0	2	9
Terre Haute	1	-------	0	1	2	0	0	0	0	0	19

City reports for week ended October 15, 1932—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Illinois:											
Chicago	20	4	1	18	40	81	0	29	0	22	614
Springfield	1		1	1	0	10	0	0	0	0	23
Michigan:											
Detroit	11		2	8	13	52	0	13	2	46	207
Flint	1	23	0	0	2	4	0	0	1	2	25
Grand Rapids	0		0	0	2	2	0	1	0	9	33
Wisconsin:											
Kenosha	0		0	0	0	2	0	0	0	0	5
Madison	1			3		0	0		0	2	
Milwaukee	4	1	1	1	7	9	0	5	0	10	91
Racine	0		0	1	0	1	0	0	0	2	8
Superior	1		0	0	0	0	0	1	0	0	10
Minnesota:											
Duluth	0		0	0	4	2	0	0	0	5	27
Minneapolis	1		0	5	4	13	0	3	0	5	105
St. Paul	3		0	1	10	8	0	1	2	20	70
Iowa:											
Des Moines	20			0		8	0		0	0	26
Sioux City	3			0		1	1		0	0	
Waterloo	0			1		0	0		0	1	
Missouri:											
Kansas City	3		0	4	7	22	0	4	0	8	102
St. Joseph	9		0	0	7	1	0	1	0	0	38
St. Louis	22		0	0	5	16	0	9	2	0	180
North Dakota:											
Fargo	0		0	0	0	0	0	0	0	0	4
Grand Forks	0		0	3	0	0	0	0	1	0	
South Dakota:											
Aberdeen	0		0	0	0	0	0	0	0	0	
Sioux Falls	0		0	0	0	0	0	0	0	0	9
Nebraska:											
Omaha	16		0	1	3	16	0	1	0	0	42
Kansas:											
Topeka	1		0	0	0	1	0	0	1	0	3
Wichita	2		0	0	3	3	0	0	0	1	26
Delaware:											
Wilmington	1		0	0	3	1	0	1	0	2	29
Maryland:											
Baltimore	6	1	0	0	13	22	0	14	4	32	101
Cumberland	1	1	0	0	1	1	0	1	1	0	10
Frederick	0		0	0	0	2	0	0	0	0	
District of Columbia:											
Washington	5	1	1	0	10	13	0	10	0	8	142
Virginia:											
Lynchburg	2		0	0	1	1	0	1	1	3	8
Norfolk	0		0	1	4	2	0	3	0	3	20
Richmond	3		1	2	3	7	0	1	1	0	55
Roanoke	5		0	0	0	11	0	0	8	1	12
West Virginia:											
Charleston	0		0	0	0	0	0	0	0	0	17
Huntington	7		0	0	0	6	0	0	0	0	
Wheeling	0		0	6	3	2	0	0	0	0	16
North Carolina:											
Raleigh											
Wilmington	2		0	0	1	4	0	1	0	0	7
Winston-Salem	3		0	1	1	1	0	2	0	1	15
South Carolina:											
Charleston	0	8	0	1	0	0	0	1	1	0	26
Columbia	0		0	0	0	0	0	1	0	1	4
Greenville	1		0	0	0	1	0	0	0	0	
Georgia:											
Atlanta	20	13	0	0	4	4	0	2	3	9	87
Brunswick	0		0	0	0	0	0	0	0	0	4
Savannah	11	16	0	1	2	1	0	2	3	0	20
Florida:											
Miami	2	1	0	0	0	0	0	1	0	4	25
St. Petersburg											
Tampa	1		0	0	1	0	0	2	0	0	23
Kentucky:											
Covington											
Lexington	3		0	0	2	4	0	1	0	0	11
Louisville	10	1	0	1	2	5	0	1	1	5	49
Tennessee:											
Memphis	12		0	0	9	15	0	4	2	0	91
Nashville	2		0	0	4	4	0	1	0	0	41
Alabama:											
Birmingham	16	4	0	0	4	5	0	2	2	2	54
Mobile	2	1	0	0	0	5	0	3	0	0	22
Montgomery	1		0	0		2	0		0	3	

City reports for week ended October 15, 1932—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Arkansas:											
Fort Smith	1			0		0	0		0	0	
Little Rock	2		0	1	3	3	0	0	0	0	3
Louisiana:											
New Orleans	19	1	3	2	6	5	0	9	1	0	135
Shreveport	1		0	0	1	1	0	1	0	0	31
Oklahoma:											
Oklahoma City	17	10	0	0	5	7	0	1	2	0	29
Tulsa	9		0	0	0	5	0	0	1	0	2
Texas:											
Dallas	30		0	0	3	13	0	1	1	0	56
Fort Worth	11		0	10	2	9	0	2	0	0	23
Galveston	3		0	0	2	0	0	1	3	0	6
Houston	16		0	0	4	1	0	4	1	0	68
San Antonio	11		2	0	2	5	0	5	1	0	58
Montana:											
Billings	0		0	0	0	2	0	0	0	0	5
Great Falls	0		0	2	0	1	0	1	0	0	6
Helena	0		0	0	0	0	0	0	0	0	3
Missoula	0		0	0	0	0	0	0	1	0	3
Idaho:											
Boise	0		0	0	0	1	6	0	1	0	3
Colorado:											
Denver	5		0	7	13	15	0	6	0	1	88
Pueblo	1		0	0	0	0	0	0	0	4	8
New Mexico:											
Albuquerque	0	4	0	0	0	2	0	0	1	0	7
Arizona:											
Phoenix	0		0	0	0	0	0	1	0	0	
Utah:											
Salt Lake City	1		0	1	1	3	0	1	0	4	27
Nevada:											
Reno											
Washington:											
Seattle	1			0		3	1		0	2	
Spokane	0			1		2	0		1	0	
Tacoma	0		1	0	4	0	0	0	1	0	21
Oregon:											
Portland	0	2	0	1	5	3	0	1	0	1	65
Salem	0		0	2	0	0	0	0	0	0	
California:											
Los Angeles	26	78	2	2	7	23	0	19	1	22	247
Sacramento	0		0	1	2	1	0	0	1	2	28
San Francisco	3	5	0	1	5	1	0	9	0	23	128

State and city	Meningococcus meningitis		Poliomyelitis cases	State and city	Meningococcus meningitis		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Maine:				Minnesota:			
Portland	0	0	1	Minneapolis	0	0	1
Massachusetts:				Iowa:			
Boston	1	1	1	Sioux City	0	0	1
New York:				Missouri:			
New York	1	3	10	Kansas City	1	1	0
Pennsylvania:				St. Louis	1	1	0
Philadelphia	0	0	18	Nebraska:			
Pittsburgh	0	1	0	Omaha	1	0	0
Reading	0	0	1	District of Columbia:			
Scranton	0	0	1	Washington	0	0	2
Ohio:				Tennessee:			
Cincinnati	1	0	0	Memphis	2	0	0
Indiana:				Texas:			
South Bend	0	1	0	Houston	0	0	1
Illinois:				Washington:			
Chicago	1	0	2	Seattle	0	0	3
Michigan:				Spokane	0	0	1
Detroit	0	0	2				
Grand Rapids	0	0	1				

Lethargic encephalitis.—Cases: Philadelphia, 1; Pittsburgh, 1; Chicago, 1; Detroit, 1.
Pellagra.—Cases: Boston, 1; Philadelphia, 1; Charleston, S. C., 3; Savannah, 1; Dallas, 1; Los Angeles, 1.
Typhus fever.—Cases: New York City, 1; Savannah, 4; Houston, 1.

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—Week ended October 8, 1932.—The Department of Pensions and National Health of Canada reports cases of certain communicable diseases for the week ended October 8, 1932, as follows:

Disease	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis			3						3
Chicken pox		4	8	72	21	13	31	11	160
Diphtheria	1	4	30	15	5		1		56
Erysipelas			1		1		1		3
Influenza	6							3	9
Measles	1	12	23	47	2		66	69	220
Mumps				48	3	6		8	65
Paratyphoid fever				1	1				2
Pneumonia				8		1		2	11
Poliomyelitis			51	14		1	4		70
Scarlet fever	3	6	62	28	15	14	3	24	155
Tuberculosis	1	17	52	38	4	5		26	143
Typhoid fever	6	1	37	13	2	4	4		67
Undulant fever				8					8
Whooping cough			47	53	16	9		6	131

JAMAICA

Communicable diseases—Four weeks ended October 8, 1932.—During the four weeks ended October 8, 1932, cases of certain communicable diseases were reported in Kingston, Jamaica, and in the island of Jamaica outside of Kingston as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Cerebrospinal meningitis	1		Poliomyelitis		1
Chicken pox	1	8	Puerperal fever		3
Diphtheria	2		Tuberculosis	30	77
Dysentery		4	Typhoid fever	10	62
Leprosy		1			

PUERTO RICO

Influenza.—From July 1 to September 19, 1932, 40,165 cases of an acute respiratory disease diagnosed as influenza were reported in Puerto Rico.

The disease was mild, as indicated by the accompanying table, which gives a comparison of deaths from influenza, pneumonia, and bronchitis for July and August, 1931 and 1932.

Cause of death	July		August		Total	
	1931	1932	1931	1932	1931	1932
Influenza	17	12	18	109	35	121
Pneumonia	105	121	86	98	191	219
Bronchopneumonia	212	157	163	200	375	357
Bronchitis	80	74	79	75	159	149
Total	414	364	346	482	760	846

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

(NOTE.—A table giving current information of the world prevalence of the quarantinable diseases appeared in the Public Health Reports for October 28, 1932, pp. 2123-2136. A similar cumulative table will appear in the Public Health Reports to be issued November 26, 1932, and thereafter, at least for the time being, in the issue published on the last Friday of each month.)

CHOLERA

Philippine Islands.—During the week ended October 22, 1932, 15 cases of cholera with 15 deaths were reported in the Province of Samar, P. I.

PLAGUE

Egypt—Alexandria.—Three cases of plague with 3 deaths were reported at Alexandria, Egypt, during the week ended October 15, 1932.

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